Modification Structure of CoS₂ Electrocatalysts towards Enhanced Oxygen Evolution by Nitrogen Doping

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The sluggish kinetics of the electrochemical oxygen evolution reaction (OER) usually requires using precious metal-based electrocatalysts to lower energy barriers. Designing and developing highly efficient and stable electrocatalysts made of nonprecious elements for OER remain a significant challenge. Herein, a fabrication of nitrogen-doped CoS₂ via a facile method, and their different electrocatalytic performance in response to variations in nitrogen doping is demonstrated. Urea and NH₄F are nitrogen containing reactants whose amino groups have a strong interaction with Co²⁺ ions, resulting in a nitrogen containing precursor. After a sulfidation process, nitrogen doped CoS₂ is obtained. An addition of a hydrogen annealing step enables the nitrogen doping process to load between 0 and 13.6%. Nitrogen doping has a significant effect on the distribution of sulfur in CoS₂, which significantly improves the quality or quantity of active sites. As a result, the nitrogen-doped CoS₂ shows high electrochemical activity toward OER. Notably, the N₄-CoS₂-400 sample exhibits a small overpotential of 290 mV to provide a current density of 10 mA cm⁻². The results in this study provide information for the utilization of heteroatoms in a rational design for enhancing electrochemical performance toward OER and may create new opportunities in other energy-related areas.

Keywords: Nitrogen doped CoS₂, Hydrogen annealing, OER, heteroatom, electrocatalysts.

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